

New US Patent Application filed September 29, 2006  
Preliminary Amendment

Amendments to the Specification

Please insert the following new paragraph and subtitle immediately following the title of the application on page 1:

This application claims priority to PCT/EP2005/002856, filed on March 17, 2005, which claims priority to DE102004045031.5 filed on September 15, 2004 and to DE102004016764.8 filed on April 1, 2004.

Technical Field

Please add the following subtitle at line 5 on page 1 with the following :

Background

Please amend the paragraph beginning on line 6 page 1 with the following amended paragraph:

Gas valves are known which are opened and closed via a relay. It is also known for such relays for opening and closing gas valves to be activated via a control device, often in the form of ~~developed as~~ a microprocessor. It can be ~~is~~ important here that the overall arrangement is failsafe, i.e. that a gas valve is only opened via a relay when the control device is in a defined state. If an undefined state of the control device is present, it is desirable ~~must be ensured~~ that the relay not ~~cannot~~ open the gas valve. For this, control circuits for relay-operated gas valves sometimes have a failsafe circuit in addition to the relay, where the this ~~this~~ failsafe circuit being is ~~being~~ connected between the control device ~~developed as a microprocessor~~, and the relay. The failsafe circuit may help ensure the failure safety of the ~~overall arrangement is ensured by the use of such failsafe circuits.~~

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Please delete the paragraph beginning at line 22 on page 1 which starts with "Starting from this,".

Please add the following new subtitle at line 25, page 1:

Summary

Please amend the paragraph beginning on line 26 page 1 with the following amended paragraph:

~~This problem is solved with a control circuit for relay-operated gas valves with the features of Claim 1.~~ According to one illustrative embodiment of the present invention, ~~the~~ a control circuit may be provided that includes a relay for opening and/or closing a gas valve, and a failsafe circuit~~[[, a]]~~. A control device may be being connectable to one or more input of the failsafe circuit, and the failsafe circuit may be adapted to only supply~~[[ing]]~~ the relay with a voltage and/or current necessary for opening the gas valve when an input signal supplied at an input of the failsafe circuit by the control device has, for example, having at least two different frequency signals succeeding each other in time ~~is supplied at an input of the failsafe circuit by the control device.~~

Please amend the paragraph beginning on line 38 page 1 with the following amended paragraph:

~~It is the intention of the present invention to suggest a control circuit for relay-operated gas valves which include a failsafe circuit, the failsafe circuit only supplying the relay with a voltage necessary for opening the gas valve when the~~

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~~control device supplies an input signal for the failsafe circuit, said signal having two different frequency signals defined as successive in time. In accordance with this illustrative embodiment, the~~ The relay can accordingly only open a gas valve if the signal supplied by the control device contains the two frequency signals in the time-defined order. If only one of the two frequency signals is present, the relay cannot open the gas valve. This helps ensure ~~It is thereby always ensured~~ that the relay can only actuate the gas valve if the control device, often in the form of ~~developed as~~ a microprocessor, is working properly. If the control device supplies a signal with other frequencies or a different time sequence of frequencies at the input of the failsafe circuit, the gas valve may be closed, ~~sometimes closes~~ immediately.

Please amend the paragraph beginning on line 18 page 2 with the following amended paragraph:

In some illustrative embodiments ~~According to a preferred development of the invention,~~ the control circuit may have ~~has~~ a charging circuit and a drive circuit for the relay. In some cases, the ~~The~~ charging circuit has at least one capacitor, the charging circuit charging the at least one capacitor ~~or each capacitor~~ of the charging circuit upon the application or presence of a first frequency signal in the input signal. Upon the application or presence of a second frequency signal, on the other hand, the at least one capacitor ~~or each capacitor~~ of the charging circuit discharges itself. Upon the application or presence of the second frequency signal in the input signal, the

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drive circuit for the relay may supply ~~supplies~~ the relay with a voltage and/or current necessary for opening the gas valve.

Please amend the paragraph beginning on line 33 page 2 with the following amended paragraph:

In some cases, the ~~The~~ drive circuit may have ~~preferably has~~ at least two transistors, a base of a first transistor being connected via a resistor to the capacitor of the charging circuit, and the first transistor of the drive circuit only conducting when the capacitor of the charging circuit discharges itself upon the application of the second frequency signal in the input signal.

Please add the following new subtitle immediately following the paragraph ending on page 3 line 2:

Brief Description

Please delete the paragraph beginning at line 4, page 3 which starts with "Preferred developments of".

Please add the following new paragraph at line 9 of page 3:

The invention may be more completely understood in consideration of the following detailed description of an illustrative embodiment of the present invention in connection with the accompanying drawings, without being restricted to this or other illustrative embodiment, in which:

Please amend the paragraph beginning on line 10 page 3 with the following amended paragraph:

Fig. 1[[:]] shows a circuit diagram of an illustrative control circuit ~~according to the invention for that can be used in conjunction with~~ relay-operated gas valves; and  
Fig. 2[[:]] shows a timing diagram for clarifying the functioning of the illustrative control circuit of Fig. 1 ~~according to the invention for relay-operated gas valves.~~

Please amend the paragraph beginning on line 17 page 3 with the following amended paragraph:

An illustrative embodiment of the ~~This~~ present invention will now be described in greater detail with reference to Fig. 1 and Fig. 2.

Please amend the paragraph beginning on line 20 page 3 with the following amended paragraph:

Fig. 1 shows a control circuit 10 according to one illustrative embodiment ~~the invention~~ for relay-operated gas valves[[,]]. ~~The illustrative the control circuit according to the invention including~~ includes a relay 11 and a failsafe circuit 12 for the relay 11. The illustrative failsafe circuit 12 has an input 13, at which a control device, not shown, in particular a control device such as ~~developed as~~ a microprocessor, can be connected. The control device supplies an input signal at the input 13 of the failsafe circuit 12 or at the input 13 of the control circuit 10[[,]] ~~in the sense of this present invention the.~~ The failsafe circuit 12 may be adapted to then only supply[[ing]] at the relay 11 ~~with~~ a voltage and/or current necessary for opening the gas valve when, for example, a signal having at least two

different frequency signals succeeding each other in time is supplied at the input 13 by the control device.

Please amend the paragraph beginning on line 36 page 3 with the following amended paragraph:

In one illustrative embodiment, and not to be limiting,  
~~In the sense of this present invention,~~ the failsafe circuit 12 of the control circuit 10 ~~according to the invention includes~~ may include a charging circuit 14 and a drive circuit 15. The illustrative charging circuit 14 includes the components surrounded by a dashed box in Fig. 1; the components of the drive circuit 15 are surrounded in Fig. 1 by a dotted and dashed box.

Please amend the paragraph beginning on line 7 page 4 with the following amended paragraph:

As can be seen from Fig. 1, the illustrative charging circuit 14 includes a capacitor 16, with two diodes 17 and 18 connected in parallel to the capacitor 16. Fig. 1 shows that the cathode of the diode 18 is in contact with the anode of the diode 17. The capacitor 16 is connected in parallel to the two diodes 17 and 18 in such a manner that the capacitor is in contact with the cathode of the diode 17 on one side and with the anode of the diode 18 on the other side. Connected between the two diodes 17 and 18 is a resistor 19, which with interposed capacitors 20, 21, 22 and 23 is connected to the input 13 of the failsafe circuit 12. Instead of the four capacitors 20 to 23 shown in Fig. 1, it is also possible to use only one capacitor, or any other number of capacitors as desired of appropriately sized capacity.

Please amend the paragraph beginning on line 23 page 4 with the following amended paragraph:

The illustrative drive circuit 15 includes, among other things, two transistors 24 and 25. A first transistor 24 is connected with its base to the capacitor 16 of the charging circuit 14, with an interposed resistor 26. The collector of the transistor 24, which according to the illustrative embodiment of Fig. 1, is developed as an NPN transistor, is connected with an interposed further resistor 27 to a supply voltage V of the control circuit 10~~—according to the invention~~. With its emitter, on the other hand, the transistor 24 is connected to a ground potential or earth potential. A second transistor 25 is switched with the first transistor 24 in such a manner that the collector of the second transistor 25, which like the first transistor 24 is developed as an NPN transistor, is connected to the base of the first transistor 24. The emitter of the second transistor 25 is connected, like the emitter of the first transistor 24, to the ground potential or earth potential. The base of the second transistor 25 is connected with an interposed resistor 28 to the input 13 of the control circuit 10.

Please amend the paragraph beginning on line 7 page 5 with the following amended paragraph:

According to the illustrative embodiment of Fig. 1, the illustrative drive circuit 15 may include ~~includes~~, in addition to the two transistors 24, 25 and the resistors 26, 27 and 28, ~~further~~ two Darlington transistor circuits 29 and 30, each of which has two transistors switched in the so-called Darlington circuit. According to Fig. 1, the two transistors of the

Darlington transistor circuit 29 are developed as NPN transistors, the two transistors of the Darlington transistor circuit 30 on the other hand being developed as PNP transistors. In the illustrative embodiment, the ~~The~~ two Darlington transistor circuits 29 and 30 are connected together at their base and coupled to the collector of transistor 24. It can further be seen from Fig. 1 that the emitters of the Darlington transistor circuits 29 and 30 may ~~are~~ also be connected to each other, a series connection of a resistor 32 and a capacitor 33 being in contact at this connection point 31 of the emitters. The collector of the Darlington transistor circuit 29 is shown connected to ~~on~~ the potential of the supply voltage V; the collector of the Darlington transistor circuit 30, on the other hand, is shown connected to ~~on~~ the ground potential together with the emitters of the transistors 24 and 25. A diode 34 is connected in parallel to the relay 11, the diode 34 being connected ~~switched~~ with its anode coupled to the collector of the Darlington transistor circuit 29 and with its cathode coupled to ~~with~~ the capacitor 33.

Please amend the paragraph beginning on line 34 page 5 with the following amended paragraph:

As already mentioned, the illustrative control circuit 10 ~~according to the invention~~ or the failsafe circuit 12 of the same may only supply ~~supplies~~ the relay 11 with a voltage necessary for opening the gas valve when, for example, an input signal including at least two different frequency signals succeeding each other in time is supplied at the input 13 of the failsafe circuit 12 by the control device. In this case a defined



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operating state of the control device for opening the gas valve is present.

Please amend the paragraph beginning on line 7 page 6 with the following amended paragraph:

In one illustrative embodiment, and although not required, in the preferred embodiment of this present invention, the gas valve may be ~~is~~ only opened by the relay 11 if the signal supplied by the control device at the input 13 includes two frequency signals, namely a first frequency signal with a frequency of around 1000 kHz and a second frequency signal with a frequency of around 5 kHz, which are applied or present succeeding one another in time in such a manner in the signal supplied by the control device, that in each case a time span of around 40 ms with the first frequency signal of around 1000 kHz is followed by a time span of around 80 ms with the second frequency signal of around 5 kHz. Fig. 2 visualizes such an input signal, as supplied by the control device, as a solid line, where in each case a time span  $t_1$  with the frequency signal of around 1000 kHz is followed by a time span  $t_2$  with the frequency signal of around 5 kHz.

Please amend the paragraph beginning on line 25 page 6 with the following amended paragraph:

The illustrative control circuit 10 ~~according to the invention now works~~ may work in such a manner that upon the application or presence of the first frequency signal of around 1000 kHz at the input 13 of the failsafe circuit 12, the charging circuit 14 charges the capacitor 16 of same. During the application of the

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second frequency signal of around 5 kHz at the input 13, on the other hand, the capacitor 16 of the charging circuit 14 cannot be charged, but instead during the time span in which the second frequency signal of around 5 kHz is applied, a discharge of the capacitor 16 of the charging circuit 14 takes place through ~~over~~ the resistor 26 and the base of the transistor 24. It should further be noted that during the time span in which the second frequency signal of around 5 kHz is applied at the input 13, there may be ~~is~~ a generally rectangular 5 kHz signal at the connection point 31. Thereby, on the one hand, the capacitor 33 of the drive circuit 15 is charged over the diode 34, and on the other hand there is a discharge over the relay 11. In the discharge, a direct current may flow ~~flows~~ through the relay 11. In the time span in which the first frequency signal of around 1000 kHz is applied, the capacitor 33 of the drive circuit 15 can also discharge over the relay 11. In the illustrative embodiment, the ~~The~~ transistor 24 of the drive circuit 15 is only conducting if from the discharge of the capacitor 16 a current flows at its base.

Please amend the paragraph beginning on line 15 page 7 with the following amended paragraph:

During the time span in which the first frequency signal with the relatively high frequency of around 1000 kHz is applied at the input 13, the capacitor 16 of the charging circuit 14 is indeed being charged, but the drive circuit 15 is not conducting because of, for example, the so-called feedback capacity of the transistor 25 and because of the relatively large resistor 28. In the illustrative embodiment, the ~~The~~ drive circuit 15 is only

conducting when, during the time span in which the second frequency signal with the relatively low frequency of 5 kHz is applied at the input 13, the capacitor 16 of the charging circuit 14 discharges through ~~over~~ the resistor 26 and the base of the first transistor 24. The charging and discharging of the capacitor 16 of the charging circuit 14 during the time spans  $t_1$  and  $t_2$  with the different frequency signals is represented in Fig. 2 by the broken line 35. As can be seen from Fig. 2, the capacitor 16 is charged during the time span  $t_1$  in which the first frequency signal of around 1000 kHz is applied, while a discharge of the capacitor 16 occurs during the time span  $t_2$  in which the second frequency signal of around 5 kHz is applied.

Please amend the paragraph beginning on line 1 page 8 with the following amended paragraph:

By supplying a signal at the input 13 of the control circuit 10 ~~according to the invention~~, in which the signal includes the two frequency signals of around 1000 kHz and around 5 kHz succeeding each other in a defined time, a voltage and/or current necessary to open the gas valve can be permanently supplied at the relay 11. In the time span in which the first frequency signal of around 1000 kHz is applied at the input 13, the capacitor 33 of the drive circuit 15 discharges, as a result of which the voltage and/or current necessary to open the gas valve is maintained at the relay 11. During the time span for which the second frequency signal of around 5 kHz is applied at the input 13 and the capacitor 16 of the charging circuit 14 discharges, the drive circuit 15 is conducting and there is a rectangular 5 kHz signal at the connection point 31. As a result of this, on

the one hand the capacitor 33 is charged over the diode 34, and on the other hand there is a discharge over the relay 11. In the discharge a direct current flows through the relay 11. During the presence of the first frequency signal of around 1000 kHz, the transistor 25 is continuously conducting, as a result of which the voltage at the emitters of the Darlington transistor circuits 29 and 30 becomes high. Since during the time span in which the first frequency signal of around 1000 kHz is applied at the input 13, the voltage necessary to open the gas valve is maintained at the relay 11 by the discharge of the capacitor 33, this time typically should ~~must~~ be shorter than the discharge time of the capacitor 33.

Please amend the paragraph beginning on line 31 page 8 with the following amended paragraph:

The actual design of the control circuit described above is up to the person skilled in the art who is addressed here. In the especially preferred embodiment, the capacitance of the capacitor 16 of the charging circuit is 10  $\mu\text{F}$ , the capacitance of each of the capacitors 20, 21, 22, 23 is 100 pF. The capacitance of the capacitor 33 of the drive circuit is preferably 47  $\mu\text{F}$ . The resistor 19 is preferably sized at 1 k $\Omega$ , the resistor 28 at 1 M $\Omega$ . The resistor 26 is preferably 47 k $\Omega$ , the resistor 27 100 k $\Omega$ . The resistor 32 is preferably 51 $\Omega$ . The supply voltage V is 24 V. With this sizing for the circuit components, the discharge time of the capacitor 16 through ~~over~~ the resistor 26 is about 116 ms, its charge time is about 40 ms.